TA lib

May 1, 2018

```
In [1]: %pylab inline
```

```
Populating the interactive namespace from numpy and matplotlib
```

1 Technical Analysis Library (*ta_lib*)

1.1 Overview

1.1.1 Abstract

This library is a sub-system of the algorithmic trading application. This library provides all the technical indicators. The indicators are provided by appending them to the original dataframe which holds the chart data.

1.1.2 Functionality

The library supports the following technical indicators:

- **Daily returns**: `daily_returns(df, source_column, target_column)`
- **Simple moving average**: `sma(df, periods, source_column, target_column)`
- **Weighted moving average**: `wma(df, periods, source_column, target_column)`
- **Exponential moving average**: `ema(df, periods, source_column, target_column)`
- **Simple moving stdev**: `std(df, periods, source_column, target_column)`
- **Bollinger bands**: `bbands(df, periods, source_column, target_column)`
- **Relative strength index**: `rsi(df, periods, source_column, target_column)`

Ideas:

- Parabolic SAR
- MACD
- Bollinger Band % (distance)
- Average True Range (ATR)
- Single candle pattern detection
- Clouds
- Heiken-Ashi

Local (High/Low) Range % (`local_range`)
For any window n:

- local high = max(window)
- local low = min(window)
- local range = local high - local low
- range % = (current - local low) / local range

1.1.3 Test data

The following USDT_BTC chart is used to the test and display the indicators in this notebook.

```
In [2]: import poloniex as plnx
        import pandas as pd
        from datetime import datetime, timedelta
```

```
In [3]: pair = 'USDT_BTC'
        timeframe = 15 * 60
        end = datetime.utcnow()
        start = end - timedelta(days=0.5)
        verbose_logging = True
        chart = plnx.get_chart(pair, timeframe, start, end, verbose_logging)
```

```
https://poloniex.com/public?command=returnChartData&currencyPair=USDT_BTC&start=1525042762&end=
Retrieved 48 records.
```

1.2 Daily returns

```
In [4]: def daily_returns(df, source_column = 'close', target_column = 'daily_return'):
            df[target_column] = df[source_column] - df[source_column].shift(1)
```

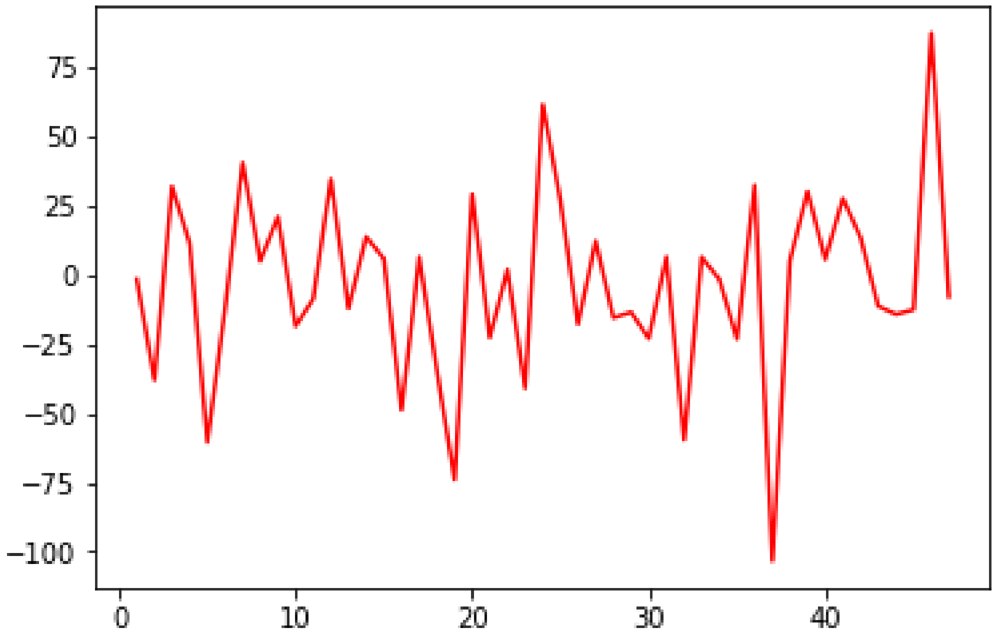
```
In [5]: daily_returns(chart)
```

```
In [6]: chart.head()
```

```
Out[6]:          close                 date         high          low         open  \
        0  9431.641721  2018-04-30 01:00:00  9432.934620  9390.000000  9402.720313
        1  9430.000000  2018-04-30 01:15:00  9431.512595  9390.117883  9431.512595
        2  9392.022381  2018-04-30 01:30:00  9430.067142  9390.000000  9430.000000
        3  9423.799996  2018-04-30 01:45:00  9429.534159  9392.022381  9392.022381
        4  9435.000000  2018-04-30 02:00:00  9436.738865  9409.000000  9423.799996

           daily_return
        0           NaN
        1     -1.641721
        2    -37.977619
        3     31.777616
        4     11.200004
```

```
In [7]: plot(chart['daily_return'], c='r')
```

```
Out[7]: [<matplotlib.lines.Line2D at 0x1b0e26d9d30>]
```

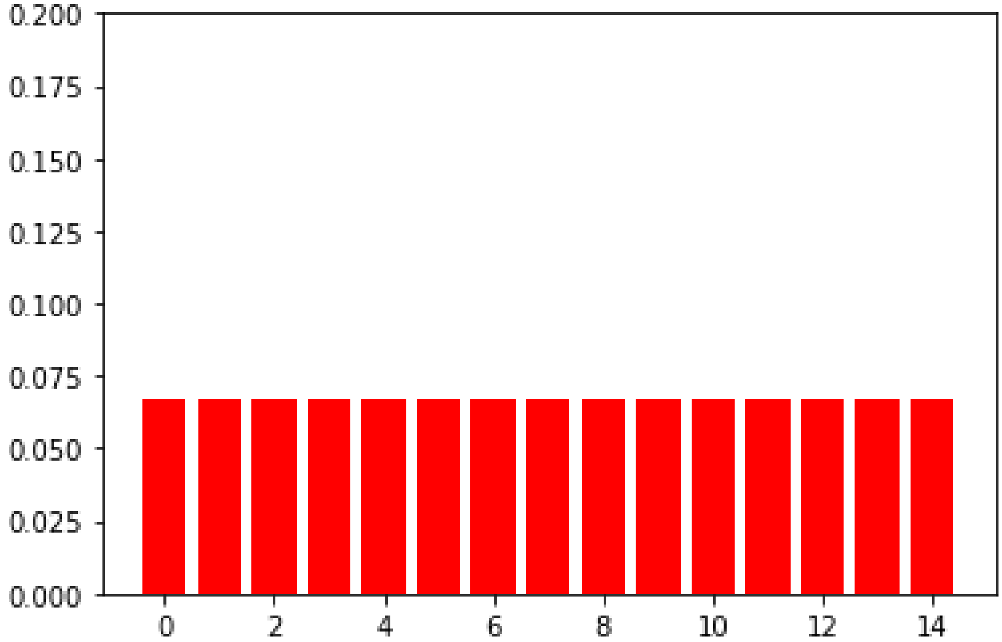


1.3 Moving Averages

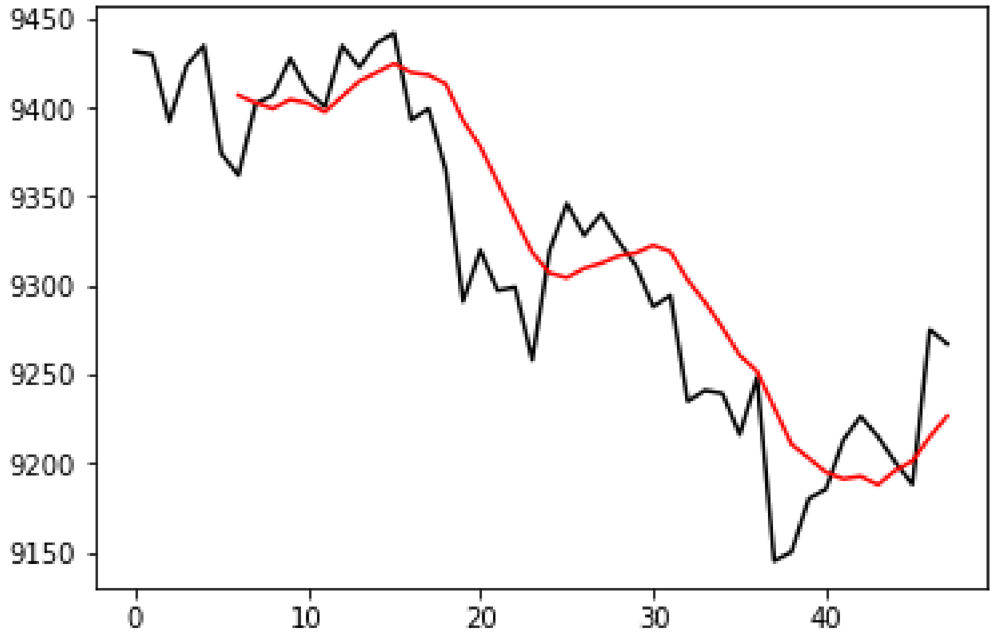
1.3.1 Simple Moving Average (SMA)

A simple moving average over n periods, and weights in each period with equal weight.

```
In [8]: x, y = range(15), [1/15]*15
        bar(x, y, facecolor='r')
        axes = plt.gca()
        axes.set_ylim(0,0.2)

Out[8]: (0, 0.2)
```



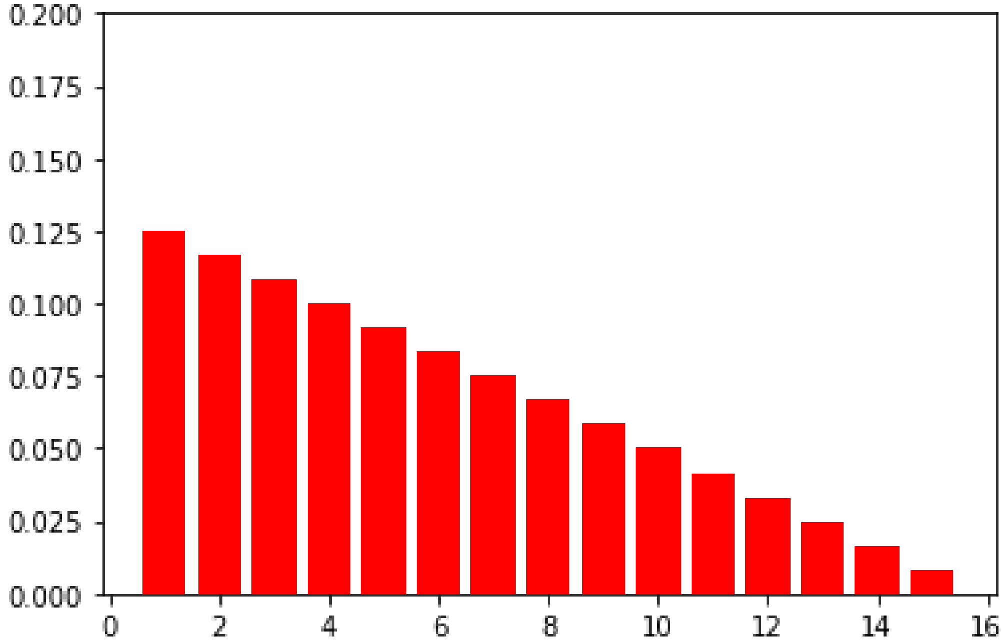

```
In [9]: def sma(df, periods = 7, source_column = 'close', target_column = 'sma'):
            df['{}{}'.format(target_column, periods)] = df[source_column].rolling(window=perioc

In [10]: sma(chart)

In [11]: chart.head()

Out[11]:          close                 date         high          low         open  \
         0  9431.641721  2018-04-30 01:00:00  9432.934620  9390.000000  9402.720313
         1  9430.000000  2018-04-30 01:15:00  9431.512595  9390.117883  9431.512595
         2  9392.022381  2018-04-30 01:30:00  9430.067142  9390.000000  9430.000000
         3  9423.799996  2018-04-30 01:45:00  9429.534159  9392.022381  9392.022381
         4  9435.000000  2018-04-30 02:00:00  9436.738865  9409.000000  9423.799996

            daily_return  sma7
         0           NaN   NaN
         1     -1.641721   NaN
         2    -37.977619   NaN
         3     31.777616   NaN
         4     11.200004   NaN

In [12]: plot(chart['close'], c='black')
         plot(chart['sma7'], c='r')

Out[12]: [<matplotlib.lines.Line2D at 0x1b0e481d630>]
```



1.3.2 Weighted Moving Average (WMA)

Moving average where the weight of later periods is linearly decreasing.

```
In [13]: def triangular(n): return n * (n + 1) / 2

In [14]: n = 15
         x = np.linspace(1, n, n)
         y = (n-x+1) / triangular(n)
         bar(x, y, facecolor='r')
         axes = plt.gca()
         axes.set_ylim(0,0.2)

Out[14]: (0, 0.2)
```



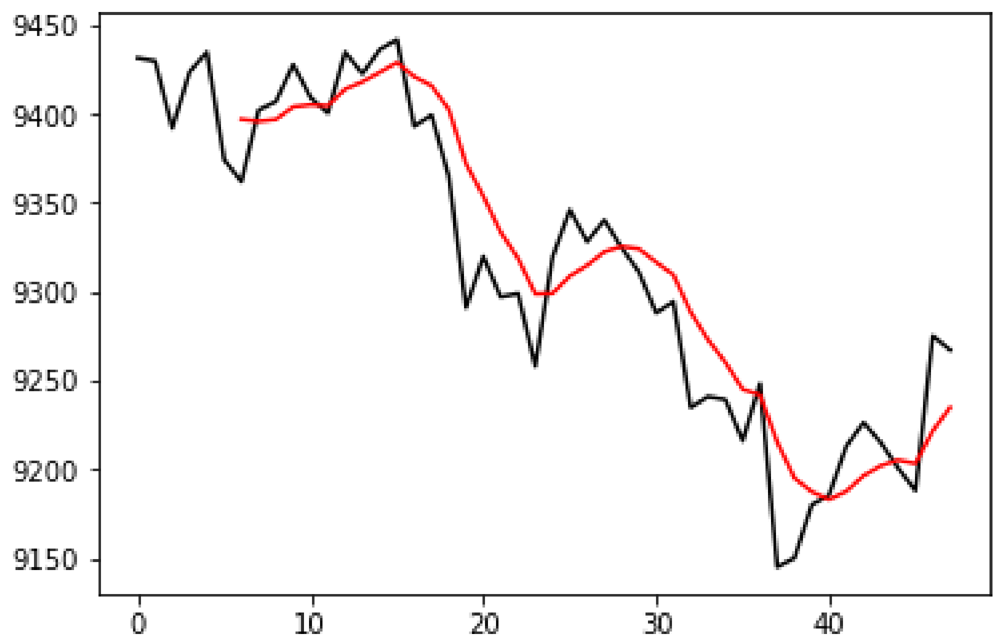

```
In [15]: from scipy.ndimage.interpolation import shift
         from pandas import Series
```

```
In [16]: def wma(df, periods = 7, source_column = 'close', target_column = 'wma'):
             x = np.linspace(1, periods, periods)
             weights = (periods-x+1) / triangular(periods)
             wma = np.convolve(weights, df[source_column], 'valid')
             wma.resize(len(wma)+periods-1)
             wma = Series(wma)
             wma = wma.shift(periods-1)
             df['{}{}'.format(target_column, periods)] = wma
```

```
In [17]: wma(chart)
```

```
In [18]: plot(chart['close'], c='black')
         plot(chart['wma7'], c='r')
```

```
Out[18]: [<matplotlib.lines.Line2D at 0x1b0f4091d68>]
```

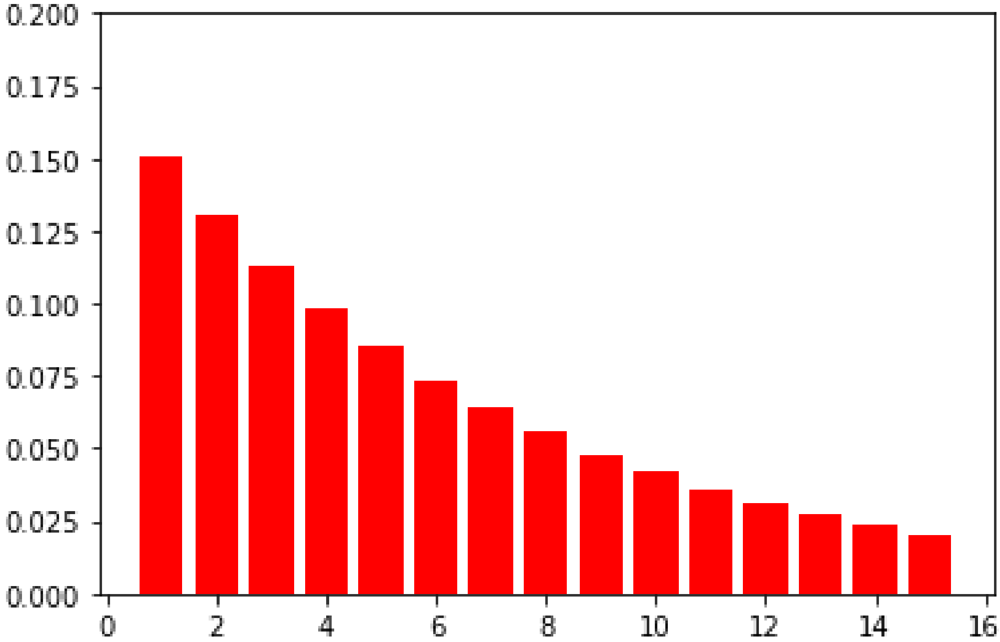


1.3.3 Exponential Moving Average (EMA)

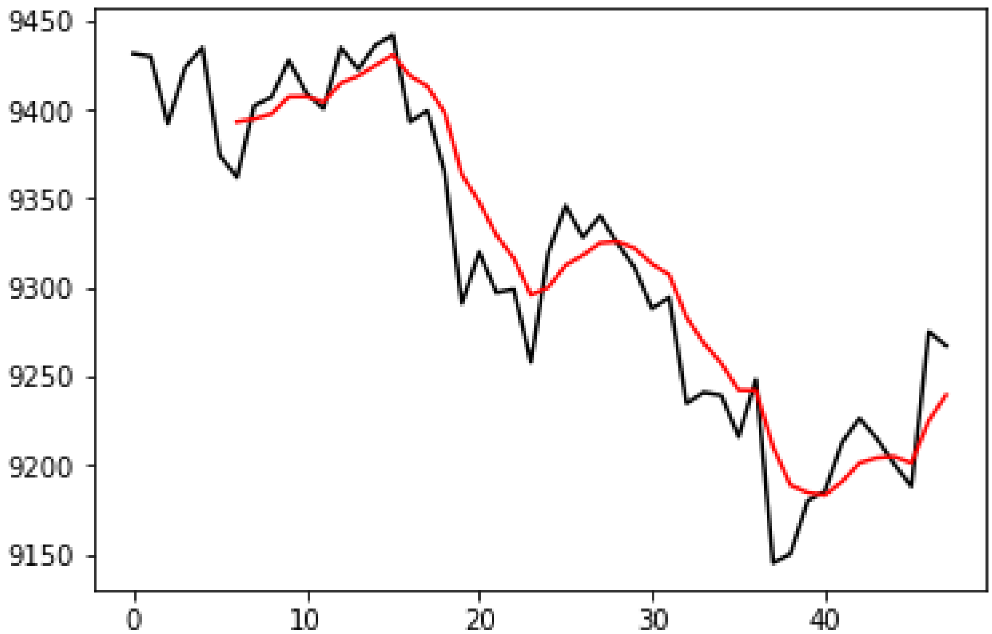
Moving average where the weight of later periods is exponentially decreasing.

```
In [52]: weights = np.exp(1-linspace(-1,1,n))
         weights /= weights.sum()
         bar(x, weights, facecolor='r')
         axes = plt.gca()
         axes.set_ylim(0,0.2)
```

```
Out[52]: (0, 0.2)
```



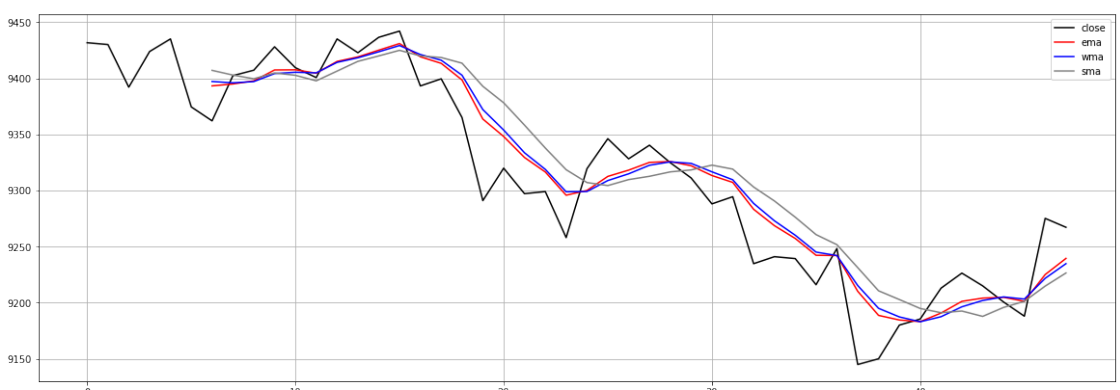

```
In [49]: sum(weights)

Out[49]: 1.0000000000000002

In [20]: from scipy.ndimage.interpolation import shift
         from pandas import Series

In [21]: def ema(df, periods = 7, source_column = 'close', target_column = 'ema'):
             weights = np.exp(1-np.linspace(-1, 1, periods))
             weights /= weights.sum()
             ema = np.convolve(weights, df[source_column], 'valid')
             ema.resize(len(ema)+periods-1)
             ema = Series(ema)
             ema = ema.shift(periods-1)
             df['{}{}'.format(target_column, periods)] = ema

In [22]: ema(chart)

In [23]: plot(chart['close'], c='black')
         plot(chart['ema7'], c='r')

Out[23]: [<matplotlib.lines.Line2D at 0x1b0f417bdd8>]
```



1.3.4 Comparison

Comparison between the SMA, WMA and EMA.

```
In [24]: ema(chart)
         plt.figure(figsize=(20,7))
         plot(chart['close'], c='black')
         plot(chart['ema7'], c='r')
         plot(chart['wma7'], c='b')
         plot(chart['sma7'], c='gray')
         legend(['close', 'ema', 'wma', 'sma'])
         grid();
```



1.4 Standard deviation

Simple moving standard deviation which is used to calculate the Bollinger bands.

In [25]:
```
def std(df, periods = 20, source_column = 'close', target_column = 'std'):
    df['{}{}'.format(target_column, periods)] = df[source_column].rolling(window=perio
```

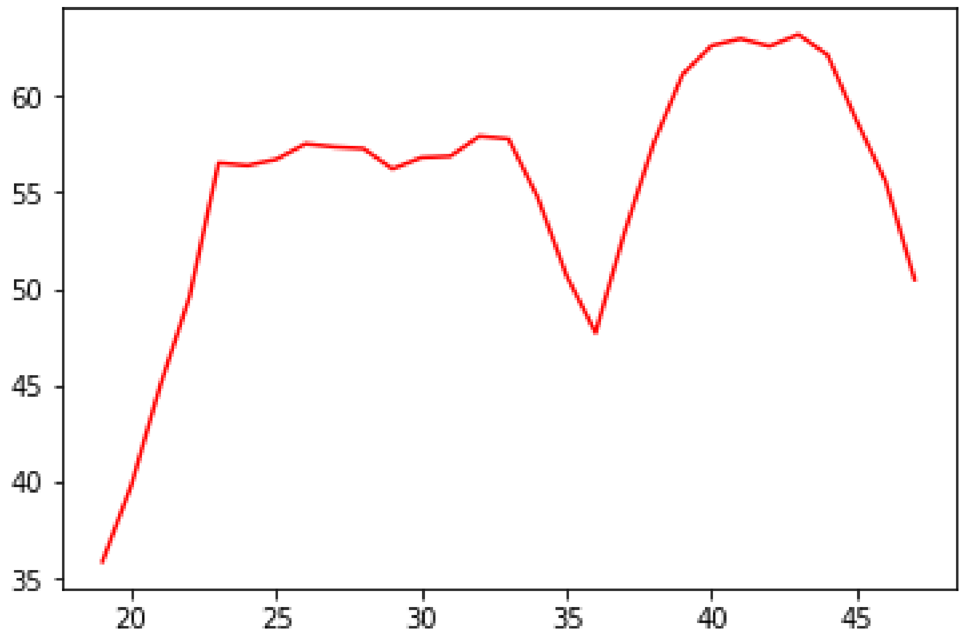
In [26]:
```
std(chart)
```

In [27]:
```
chart.head()
```

Out[27]:
```
         close                 date         high          low         open  \
0  9431.641721  2018-04-30 01:00:00  9432.934620  9390.000000  9402.720313
1  9430.000000  2018-04-30 01:15:00  9431.512595  9390.117883  9431.512595
2  9392.022381  2018-04-30 01:30:00  9430.067142  9390.000000  9430.000000
3  9423.799996  2018-04-30 01:45:00  9429.534159  9392.022381  9392.022381
4  9435.000000  2018-04-30 02:00:00  9436.738865  9409.000000  9423.799996

   daily_return  sma7  wma7  ema7  std20
0           NaN   NaN   NaN   NaN    NaN
1     -1.641721   NaN   NaN   NaN    NaN
2    -37.977619   NaN   NaN   NaN    NaN
3     31.777616   NaN   NaN   NaN    NaN
4     11.200004   NaN   NaN   NaN    NaN
```

In [28]:
```
plot(chart['std20'], c='r')
```

Out[28]:
```
[<matplotlib.lines.Line2D at 0x1b0f4264be0>]
```



1.5 Bollinger Bands

Bollinger band is calculated as follows:

- Standard deviation (σ) moving average for n periods.
- EMA for n periods
- The upper band is EMA $+ 2\sigma$.
- The lower band is EMA $- 2\sigma$.

The default period is 20.

```
In [29]: def bbands(df, periods = 20, source_column = 'close', target_column = 'bb'):
             temp_df = pd.DataFrame(df[source_column])
             std(temp_df, periods)
             ema(temp_df, periods)
             df['{}_mid'.format(target_column)] = temp_df['ema{}'.format(periods)]
             df['{}_upper'.format(target_column)] = temp_df['ema{}'.format(periods)] + 2*temp_c
             df['{}_lower'.format(target_column)] = temp_df['ema{}'.format(periods)] - 2*temp_c
```

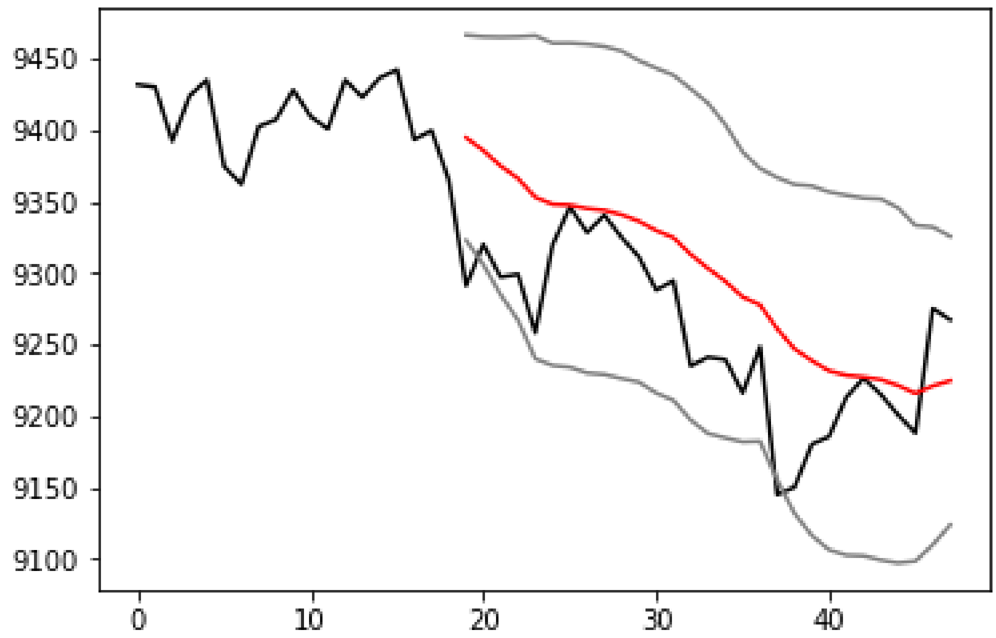
```
In [30]: bbands(chart)
```

```
In [31]: chart.head()
```

```
Out[31]:          close                 date         high          low         open  \
         0  9431.641721  2018-04-30 01:00:00  9432.934620  9390.000000  9402.720313
         1  9430.000000  2018-04-30 01:15:00  9431.512595  9390.117883  9431.512595
         2  9392.022381  2018-04-30 01:30:00  9430.067142  9390.000000  9430.000000
         3  9423.799996  2018-04-30 01:45:00  9429.534159  9392.022381  9392.022381
         4  9435.000000  2018-04-30 02:00:00  9436.738865  9409.000000  9423.799996

            daily_return  sma7  wma7  ema7  std20  bb_mid  bb_upper  bb_lower
         0           NaN   NaN   NaN   NaN    NaN     NaN       NaN       NaN
         1     -1.641721   NaN   NaN   NaN    NaN     NaN       NaN       NaN
         2    -37.977619   NaN   NaN   NaN    NaN     NaN       NaN       NaN
         3     31.777616   NaN   NaN   NaN    NaN     NaN       NaN       NaN
         4     11.200004   NaN   NaN   NaN    NaN     NaN       NaN       NaN
```

```
In [32]: plot(chart['close'], c='black')
         plot(chart['bb_mid'], c='r')
         plot(chart['bb_upper'], c='gray')
         plot(chart['bb_lower'], c='gray')
```

```
Out[32]: [<matplotlib.lines.Line2D at 0x1b0f42d52b0>]
```



1.6 Relative Strength Index (RSI)

The relative strength index is calculated with the following formula:

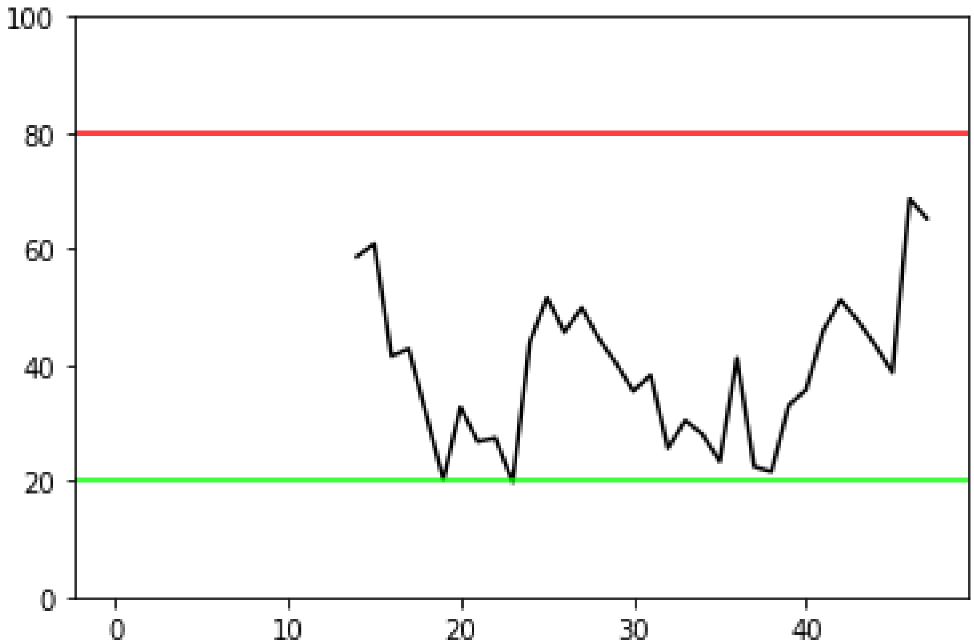
- $\text{RSI} = 100 - 100/(1 + \text{RS})$
- $\text{RS} = U/D$
- U is EMA of all positive moves in the last n periods.
- D is EMA of (absolute values of) all negative moves in the last n periods.
- n is the period of RSI.

```
In [53]: def rsi(df, periods = 14, source_column='daily_return', target_column='rsi'):
             temp_df = pd.DataFrame(df[source_column])
             temp_df['closing_gains'] = temp_df[source_column].apply(lambda x: max(x, 0))
             temp_df['closing_losses'] = temp_df[source_column].apply(lambda x: abs(min(x, 0)))
             ema(temp_df, periods, 'closing_gains', 'closing_gains_ema')
             ema(temp_df, periods, 'closing_losses', 'closing_losses_ema')
             temp_df['rs'] = temp_df['closing_gains_ema{}'.format(periods)] / temp_df['closing_
             df[target_column] = 100 - 100 / (1 + temp_df['rs'])
```

```
In [54]: rsi(chart)
```

```
In [55]: fig, ax = plt.subplots()
         plot(chart['rsi'], c='black')
         plt.axhline(y=80, c='r')
         plt.axhline(y=20, c='lime')
         ax.set_ylim(0, 100)
         fill_between(list(chart.index), 20, 80, color='grey', alpha=0)
```

Out[55]: <matplotlib.collections.PolyCollection at 0x1b0f46f0cc0>



In [36]:
```
chart.head()
```

Out[36]:
```
         close                 date         high          low         open  \
0  9431.641721  2018-04-30 01:00:00  9432.934620  9390.000000  9402.720313
1  9430.000000  2018-04-30 01:15:00  9431.512595  9390.117883  9431.512595
2  9392.022381  2018-04-30 01:30:00  9430.067142  9390.000000  9430.000000
3  9423.799996  2018-04-30 01:45:00  9429.534159  9392.022381  9392.022381
4  9435.000000  2018-04-30 02:00:00  9436.738865  9409.000000  9423.799996

   daily_return  sma7  wma7  ema7  std20  bb_mid  bb_upper  bb_lower  rsi
0           NaN   NaN   NaN   NaN    NaN     NaN       NaN       NaN  NaN
1     -1.641721   NaN   NaN   NaN    NaN     NaN       NaN       NaN  NaN
2    -37.977619   NaN   NaN   NaN    NaN     NaN       NaN       NaN  NaN
3     31.777616   NaN   NaN   NaN    NaN     NaN       NaN       NaN  NaN
4     11.200004   NaN   NaN   NaN    NaN     NaN       NaN       NaN  NaN
```

1.7 Parabolic SAR (stop and reverse)